JUPITER IN 2007:
The South Equatorial Current (SEBn jet) and South Equatorial Disturbance (SED)

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The SED had been inconspicuous until summer 2006 when the EZ darkened and the SED main complex became visible as a Great White Spot (GWS). In 2007 it was conspicuous for most of the time, and had an impressive 'stormy sector' p. it, with numerous, very high contrast 'chevrons' at most longitudes. Very-hi-res images revealed dynamic activity in the main complex and elsewhere. The diverse speeds of the main complex, the dark streaks p. it, and the small chevrons all round the zone, were similar to those in 1999/2000/2001.
See Figs.1 & 2 for maps, and Fig.3 for images, showing the SED throughout 2007.

Appearance and motions of the SED main complex

Through most of the apparition, the main complex had the classical structure of an oblique rift in SEB(N) with a bright area in EZ(S) at its mouth, with variable blue-grey shading just f. this. The New Horizons imaging in 2007 Jan. confirmed that the white and blue-grey areas together comprised an anticyclonic oval, as in the Cassini images of 2000 or the Voyager images of 1979. Sometimes the shading was weak and the whole oval appeared as a brilliant Great White Spot (GWS), as in the Voyager images.
(As usual, I take the p. end of the dark SEB(N) to mark the longitude of the SED.)

Preceding it, there were large-scale dark blue-grey streaks in EZ(S) (~15-40 deg. p. the GWS) with waves on the EB. Following it, there was often a dark reddish-brown sector of SEB(N), and a broad sector of grey-brown EB confining a narrow EZ(S).

The main complex displayed dynamic behaviour resembling that in 1999/2000, the last time that it was so conspicuous, including irregular shifts p. and f., and transformations as it passsed the GRS. The main complex passed the GRS on Feb.15 (B) and 19 (A), April 11 (B) and 14 (A), June 7, August 1, and Sep.24 (then indistinct). The mean drift of the SED main complex was DL1 = +31.3 (+/- 0.4) deg/mth throughout the apparition. However it underwent a remarkable duplication which shifted it 30 deg. eastwards in March, followed by a complex return to its original track.

Detailed chronicle of the main complex:

When first seen in January, the main complex was conspicuous, with a dark, very red patch f. it.
As it passed the GRS in mid-Feb., a new main complex (B) developed 30 deg. p. the existing one (A). This happened on Feb.23, just after passing the GRS, when a new rift broke through the SEB(N) into a pre-existing white area in EZ(S). The SEB(N) sector between B and A became very dark brown, while the reddish patch f. A faded to become a normal reddish-brown sector of SEB(N).

Throughout March, SED-B and –A travelled as a pair, ~30 deg. apart. Along with large-scale streaks further p., the SED sometimes gave the impression of a series of 3-4 waves with wavelength ~30 deg. [esp. see images on March 14: Fig.4].
In April, SED-A had lost its rift but remained as a GWS, while SED-B was a magnificent main complex, which presented a dramatic spectacle while passing the GRS on April 11 (Fig.3 & JBAA cover). SED-A disappeared by late May.
The drift of SED-A was DL1 = +31 deg/mth (Jan-Mar.), and SED-B initially moved at similar speed (Table 1, below, & Fig.6). However, SED-B decelerated from DL1 ~ +26 (Feb-Mar.) to ~+38 (Apr-May), and then underwent a remarkable shift back to the original track of A, as follows.
In late May (just as it was passing the new SEB outbreak, although this may have been mere coincidence), the rift dissociated from the GWS: the rift still had DL1 ~ +30 (continued by a white spot on the same track in early June), while the GWS had DL1 ~ +42. (See Fig.5.)
In June the GWS expanded even further f., becoming a huge white lozenge ≥30 deg. long. By the end of June its f. half had become a more distinct white oval alongside a p. end of dark SEB(N), thus restoring a coherent main complex – exactly on the original track of SED-A, which it adhered to throughout July and thereafter! *(Table 1, below, & Fig.6)* On August 5, again just after passing the GRS, a new rift broke through SEB(N) into this GWS (for the first time since the start of June).
It remained exactly on the original track of SED-A, with the same drift, DL1 = +31 (July-Sep.). This behaviour is consistent with the hypothesis that the SED is fundamentally a large-scale solitary wave, not necessarily visible, which sets up the visible rift and anticyclonic circulation (GWS) but persists if these are dissipated or perturbed. When these visible features were duplicated in the spring, apparently by a separate wave phenomenon, the underlying solitary wave persisted and deformed the GWS until it was dragged back to the original track. The same constraints may have caused smaller, discontinuous shifts f. that we reported in 1999/2000.
From mid-Aug. to late Sep., the main complex retained its classic structure, though with much lower contrast than before June, and the rift was not always open. A very dark oblique blue-grey streak in EZ(S) (splitting the previously white sector) was a conspicuous feature 15-30 deg. p. the SED. Following the SED, EZ(S) was clearer than before, but still narrow due to a broad EB.

The stormy sector

From ~15-40 deg. p. the main complex, there were large dark streaks or spots in EZ(S). In spite of their size they could not be tracked for long and they showed very diverse speeds. Close scrutiny shows this was the result of several co-existing speeds affecting them. The larger dark streaks averaged DL1 ~ 0, but their ends had speeds over short intervals ranging up to ~-60 deg/mth, no doubt because they were coupled to spots on SEBn moving with these faster speeds. Prominent dark spots slightly further p. moved rather faster (DL1 ~ -27 to -44, Table 2, below), whereas the small dark projections that appeared to be connected to them had faster speeds all along this sector (DL1 ~ -51 to -71). These speed ranges were much the same as in previous years, and may be related to the latitudes of the features.

Other longitudes: Speeds in the SEBn jetstream

Further p. there were many small dark blue-grey projections ('chevrons'), spaced ~8 deg apart, with unusually high contrast, and bright spots or streaks between them. These were prominent around most of the zone in hi-res images.

Even further p., approaching the f. side of the main complex, the projections became more diffuse and oblique, spaced ~10 deg. apart, and the grey-brown EB was broader (to the S) than p. the SED. EZ(S) f. the SED still had a dull brownish tint up to April, though clearing thereafter.

Our analysis of the small dark projections on SEBn from 1999 to 2005 (in press in JBAA) showed that these trace the peak speed of the SEBn jet, and that the speed varies with time and with longitude relative to the SED. Therefore it is specially interesting to measure the speeds of these features in 2007 when the SED was extremely active.

The JUPOS charts (Fig.7) showed numerous spot tracks at all longitudes, with speeds (DL1) ranging from -60 to -72 deg/mth, mean ~ -66 (mostly +/- 2 deg/mth) (27 dark spots, 10 white spots). There were also three white spots with slower speeds (DL1 = -50, -30, -30). This chart showed no variation in speed with longitude relative to the SED main complex. In earlier apparitions when the SED was highly active (1999/2000/2001), the speeds were similar (much lower than in years when the SED was inconspicuous), but there was a pronounced variation of speed with longitude.

To investigate further, I compiled sets of v-hi-res images closely spaced in time, where SEBn chevrons could be identified continuously with intervals of less than 48 hrs between images. This would allow features to be tracked even if they were too short-lived to show up clearly on the JUPOS chart. (An example is shown in Fig.5.) The results agreed well with the JUPOS analysis, giving mean DL1 = -62.7 (+/- 11.1, standard deviation; n=37 spots). The range was -47 to -75 deg/mth at most longitudes. In the sector p. the SED, as noted above, even slower speeds were detected for larger dark spots or streaks in the EZ(S) but these may not represent the full jet speed. In the sector f. the SED, where the highest speeds were expected but the chevrons were more elongated, speeds up to -84 (+/- 10) deg/mth were detected (Table 3 below, & Fig.8). Thus, although the data did not clearly show the gradient of speed with longitude, there is evidence that it was present but much flattened – in fact, very similar to the gradient observed during the Cassini flyby.

Speeds on SEBn, 2007:

Table 1. SED main complex:

		DL1	+/-	(deg/mth)
Mean over apparition		31.3	0.4	
In detail:				
SED-A	Jan-Apr	30.8	0.8	
SED-B	Feb-Mar.	*26*	*3*	*all*
	Apr-May	*38*	*3*	*approx.*
Rift	late May	*30*	*6*	*values*
GWS	May-June	*42*	*6*	
Dk.proj.in GWS	June	*4*	*4*	*(JUPOS)*
		28	*6*	*(JHR)*
SED	July-Sep.	31	1	

Table 2. Dark streaks and large dark spots p. main complex ('stormy sector'):

			Names	Deg.p.SED	DL1 (approx)	+/-
May	JHR	Single large dark spots	B,C,L2	20-30	0 (var.)	- 30(var.)
			A,B,C	30-50	-27	7
					-41	20
					-44	11
		Complex dark streak	B-C	30-60	~0 to -30	
June	JHR	Big dark block	L2	20-40	0	60 (ends)
	JUPOS	Same dark block			0	8

Table 3. Small SEBn features ***(as in Table for paper)*****:**

	Small spots:	mean	range		range					Main complex:	
Features	*Distance p. SED (deg)*	*-DL1 (deg/mth)*	*-DL1 (deg/mth)*	*+/-*	*u (m/s)*	*+/-*	*n*	*Lat. (deg.S)*	*+/- (SD)*	*<DL1> (deg/mth)*	*<u> (m/s)*
JUPOS: (& several slower-moving w.ss.)	30-340	66	60-72	2	134.2-139.9	1	37 (27 d, 10 w)				
JHR:	20-100	58	42-75	7-11	125.6-141.3	3.5-5.5	16(18)			31.3	90.7
	100-240	58	47-68	6-11	128.0-138.0	3-5	8(11)				
	250-310	69	60-82.5	5-7	134.2-144.9	2.5-3.5	9(10)				
	310-335	84		10	145.4	5	3				

STILL TO DO:
--- Use table of JUPOS data to obtain latitudes and more precise speeds.
--- Review multispectral images, esp. methane band.